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ADDITIONAL NOTES ON THE NUMBER AND DISTRIBUTION OF NATIVE LEGUMES IN NEBRASKA AND KANSAS.

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INTRODUCTION.

This paper presents a continuation of the observations made in Circular 31 of the Bureau of Plant Industry. It might not be out of place to say here that the counts of plants made in 1909 and also those made in previous years do not include any of the current year's seedlings of perennial species except where they attained such size that they were not readily distinguishable from the old plants. The object has always been to determine the number of established plants.

In 1909 frequent examinations were made to determine whether all the native legumes were nitrogen gathering. Practically all the prairie species of the region have been examined, and nodules have been found in abundance on every one, although they seem to be much more abundant on some species than on others. In some cases no nodules were found on some individuals, but this was probably due to the difficulty in removing the roots from the soil rather than to lack of nodules.

In general, there seem to be many more nodules on annuals in proportion to the size of the root than on perennials. As to the relative quantities of nitrogen gathered by annuals and perennials, no data have yet been obtained. Some cooperative work on this line has been begun, but it has not gone far enough for a report. Some cooperative work was also attempted in reference to cross-inoculation to determine whether the native legumes are capable of inoculating the soil for clover and alfalfa. This work failed because of bad conditions in the greenhouse. There is no doubt in the writer's mind that several of the native legumes are capable of inoculating our cultivated ones.

ROOT NODULES ON THE BUFFALO BERRY.

The writer has examined many nonleguminous plants which on account of their habitats it was suspected might be nitrogen gathering, but has failed to find nodules on any except the buffalo berry (*Lepargyraea argentea*). This shrub has great masses of nodules of all

sizes and ages on its roots. These masses on old roots are sometimes 2 inches in diameter and an inch deep. Under date of September 18, 1909, Mr. Karl F. Kellerman, Soil Bacteriologist in the Bureau of Plant Industry, wrote as follows concerning the specimens sent in from North Platte:

Referring to the roots and nodules of *Lepargyraea argentea*, the results of analyses recently reported to us from the Bureau of Chemistry are as follows: Nitrogen, percentage of root, 0.43; nitrogen, percentage of nodules, 2.31.

That the largely increased nitrogen content of the nodules is caused by the bacteria is evidenced by the fact that we have succeeded in obtaining from your specimens good cultures of nitrogen-fixing organisms.

METHOD OF OBTAINING AVERAGES.

In order to make the averages given in this circular comparable with those in Circular 31 of the Bureau of Plant Industry, the total number of plants has been divided by the total number of square yards counted. This, however, does not give what is really wanted. Each plat counted is assumed to be fairly representative of the tract from which it was chosen, and some care was taken that it should be. In some cases it was necessary to count much larger plats than in others in order to get counts which seemed representative; therefore, each plat and not each square yard should be given the same value. To get this the mean of the column headed "Average per square yard" should have been taken. The correct average number of legumes to the square yard on the tracts where observations were made in 1909 is 17.93, and for 1908, 21.58 (instead of 17.03 as given in the circular mentioned). The average for both years is 19.34. These figures seem surprisingly close together for observations made over so wide an area. It will be noticed also that most of the counts made in 1908 were in the rolling country of eastern Nebraska and Kansas, while a large part of those made in 1909 were on the level lands of south-central Nebraska.

PROPORTION IN WHICH DIFFERENT GENERA ARE FOUND.

In 1909 counts were made on 22 plats, and 4,539 legumes were found. These were distributed among the different genera as follows:

- 2,975 *Psoralea*, found on 20 out of the 22 plats.
- 519 *Amorpha*, found on 14 out of the 22 plats.
- 181 *Kuhnistera*, found on 8 out of the 22 plats.
- 139 *Astragalus*, found on 13 out of the 22 plats.
- 560 *Vicia*, found on 6 out of the 22 plats.
- 56 *Lotus*, found on 3 out of the 22 plats.
- 18 *Aragallus*, found on 6 out of the 22 plats.
- 5 *Baptisia*, found on 3 out of the 22 plats.
- 74 *Lespedeza*, found on 3 out of the 22 plats.
- 10 *Morognia*, found on 1 out of the 22 plats.
- 2 *Meibomia*, found on 2 out of the 22 plats.

TABLE I.—Number and variety of native leguminous plants on certain plats in Nebraska and Kansas east of $99\frac{1}{2}$ degrees.

Locality.	Topography and slope.	Soil.	Dominant grass.	Date of count.	Size of plat (square yards).	Legumes.		Remarks.
						Number.	Average per square yard.	
Inland, Nebr.	Level.....	Loess, Marshall loam.	Bluestem, buffalo grass, and grama grass.	June 7	15	430	28.67	Pastured 1883 to 1896. Meadow 1897.
Do.	Gently rolling, N.....	do.....	Bluestem.	do.....	5	311	62.20	Meadow 1897 to 1909. (Much Vicia.)
Do.	Level.....	do.....	do.....	do.....	10	163	16.30	Roadside adjacent to first.
Do.	do.....	do.....	do.....	do.....	10	285	28.50	Meadow.
Do.	Gently rolling, W.....	do.....	do.....	do.....	20	529	26.45	Do.
Do.	do.....	do.....	do.....	do.....	20	290	14.50	Roadside.
Do.	Gently rolling, S.....	do.....	do.....	do.....	6	78	13.00	Meadow.
Do.	Gently rolling, E.....	do.....	do.....	do.....	16	404	25.25	Much Vicia.
Nora, Nebr.	Gently rolling, SW.....	do.....	do.....	June 1	5	98	19.60	Pastured some time.
Do.	Level.....	do.....	do.....	do.....	16	142	8.88	Railroad right of way fenced.
Nelson, Nebr.	Rolling, E.....	Silt, Niobrara silt.	do.....	do.....	16	145	9.06	Meadow.
Edgar, Nebr.	Level.....	Marshall loam.	do.....	do.....	16	95	5.94	Railroad right of way fenced.
Clay Center, Nebr.	do.....	do.....	do.....	June 5	8	128	16.00	Meadow.
Hebron, Nebr.	do.....	do.....	do.....	June 1	5	89	17.80	Do.
Crab Orchard, Nebr.	Rolling, SE.....	Drift, Marshall loam.	do.....	May 21	7	132	18.86	Do.
Do.	Rolling, N.....	do.....	do.....	do.....	5	37	7.40	Meadow; about 1 Baptisia to 4 square rods.
Do.	Rolling, SW.....	do.....	do.....	do.....	9	111	12.33	Meadow; no legumes in adjoining pasture except Baptisia.
Do.	Rolling, NE.....	do.....	do.....	do.....	5	29	5.80	
Bethany, Nebr.	Rolling, SE.....	Loess, Marshall loam.	do.....	June 14	15	330	22.60	
Sacramento, Nebr.	Gently rolling, S.....	do.....	do.....	July 12	50	389	7.78	
Reece, Kans.	Rolling, S.....	Residual from carboniferous limestone.	Bluestem, buffalo grass, and grama grass.	June 25	10	165	16.50	
Fort Scott, Kans.	Rolling, NE.....	Residual from carboniferous limestone or "shale."	do.....	June 23	10	150	15.00	
					279	4,539	16.27	Total plants divided by number of square yards.
							18.11	Mean of the column.

The corresponding data for 1908 are as follows:

- 333 *Psoralea*, found on 9 out of the 14 plats.
- 185 *Amorpha*, found on 8 out of the 14 plats.
- 340 *Kuhnistera*, found on 8 out of the 14 plats.
- 12 *Astragalus*, found on 4 out of the 14 plats.
- 77 *Vicia*, found on 3 out of the 14 plats.
- 57 *Lotus*, found on 4 out of the 14 plats.
- 3 *Aragallus*, found on 1 out of the 14 plats.
- 1 *Baptisia*, found on 1 out of the 14 plats.
- 4 *Lespedeza*, found on 1 out of the 14 plats.

The variation in the relative numbers of representatives of different genera found in the two seasons is due largely to the fact that the majority of counts made in 1908 were on the rolling lands of southeastern Nebraska and in 1909 on the level prairies of the south-central part of the State. On the hills, *Kuhnistera* is much more abundant than on the level land and *Psoralea* is represented mostly by *Psoralea floribunda*, which is a very large plant, and hence the individuals are not very numerous when compared with the smaller, more gregarious *P. argophylla*, which is almost the sole representative of the genus on the more level prairies of south-central Nebraska. This plant often forms dense patches (not, however, excluding the grasses), which cover a very large proportion of the prairie, giving the whole a silvery cast.

Combining the figures for the two years we have the following totals:

- 3,308 *Psoralea*, found on 29 out of the 36 plats.
- 704 *Amorpha*, found on 22 out of the 36 plats.
- 521 *Kuhnistera*, found on 17 out of the 36 plats.
- 151 *Astragalus*, found on 17 out of the 36 plats.
- 637 *Vicia*, found on 9 out of the 36 plats.
- 123 *Lotus*, found on 7 out of the 36 plats.
- 21 *Aragallus*, found on 4 out of the 36 plats.
- 6 *Baptisia*, found on 4 out of the 36 plats.
- 78 *Lespedeza*, found on 4 out of the 36 plats.
- 10 *Morognia*, found on 1 out of the 36 plats.
- 2 *Meibomia*, found on 2 out of the 36 plats.

RELATIVE IMPORTANCE OF THE DIFFERENT GENERA.

The number of plants of the first four genera, at least, and the number of plats on which they were found probably give a fair idea of the relative importance of the representatives of these genera as nitrogen gatherers, especially when considered in connection with the sizes of the plants. It is certain that they are not all equally efficient in this work, but on this point no information is available. The large numbers of *Psoraleas* and their wide and comparatively uniform distribution, as shown by these figures, make them stand out strikingly as the most important of the group. The other genera are much less important than the first four.

TABLE II.—Number and variety of native legumes on certain plats in western Nebraska and Kansas.

Locality.	Topography and slope.	Soil.	Dominant grass.	Date of count.	Legumes.		Remarks.
					Size of plat (square yards).	Number.	
Orleans, Nebr.	Level.....	River terrace. Sandy loam.	Buffalo grass and grama grass.	July 8	100	78	0.78
	Top of hill.....	(?) Sandy loam.....	do.....	July 9	100	82	.82
Herndon, Kans.	Level.....	Loess silt loam.....	do.....	do.....	200	24	14.12
Do.....	Level.....	do.....	do.....	do.....	25	368	14.7
McDonald, Kans.	Railroad ditch 1 foot deep, 6½ feet wide.	do.....	do.....	do.....	25	252	10.1
Do.....	Railroad ditch 1 foot deep, 10 feet wide.	do.....	do.....	do.....	525	186	.35
Do.....	Level.....	Loess silt loam.....	Buffalo grass and grama grass.	do.....	3,000	439	.15
	Do.....	do.....	do.....	do.....			These two plats were adjacent to those counted in the ditch.

All but two of the *Lespedezas* were counted in 1909 on a single plat at Fort Scott, Kans., where four species were found. This genus is abundant in the vicinity. *Morognia* appeared on a single plat at Reece, Kans. This plant occurs throughout the region, but is not generally distributed over the prairies. *Vicia* is quite generally distributed, but occurs almost entirely in dense patches which occasionally cover many acres; hence the large number of individuals found on the small number of plats. It is much more common in the short-grass country than where bluestem grows. *Vicia linearis* is the only species found in the central and western part of the territory, while *V. americana* is more common in the east, where it occurs on river bottoms and in brush patches. *Baptisia* is confined to the eastern part of the territory and seldom assumes much importance because the number of plants is almost always small. *Meibomia* is also restricted to the eastern part of the territory. *Aragallus*, *Lotus*, and *Vicia* are most abundant in the short-grass country and for about 100 miles farther east. *Aragallus* is most common on the tops of hills and the banks of draws where the soil is poor.

Tables I and II show the number and variety of native legumes on some of the plats in Nebraska and Kansas.

The counts in the ditch by the railroad are in marked contrast to those on the adjoining prairie. These shallow ditches were lines of white for miles, all filled with silver-leaved *Psoralea*. Whether the dominance of *Psoralea* in the ditches is due to additional moisture or to the destruction of the grasses it is impossible to say. There is some evidence, however, that the abundance of these legumes in the ditches is due to the destruction of the grass and the removal of the soil, exposing the subsoil, which contains less nitrogen, and so is less favorable to the growth of nonleguminous plants. In many places on the level land where the grass has been killed by stock, stacks, or breaking *Psoralea* has come in thickly. In nearly all the short-grass country except where *Vicia linearis* is encountered the number of legumes is much less than in the long-grass country, but on the slopes where the soil is poor and buffalo grass and grama grass do not thrive legumes are plentiful. This suggests that it may be more the struggle with the grasses than with drought that keeps down the legumes.

Approved:

JAMES WILSON,

Secretary of Agriculture.

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